CEC 2008 IEPR Workshop on EE and Demand Forecasting

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Overview

- History of EE Potential Modeling
- Summary of ASSET and Related Potential Models
- Observations

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Introduction

- Rosenfeld/Meier: *Conservation Supply Curves*
- My experience with EE potential study forecasting
  - 1987 – present
    - Late 80s/early 1990s: CA IOUs and muni studies
    - Early - Mid 1990s: Grupo Endesa Spain
    - 2001 – present: CA IOUs, munis, Idaho Power, PNM, Xcel
      - Secret Surplus Study
    - DEER 1992 – Present
    - Evaluation and market assessment studies
- Currently working on several potential and goals-related studies:
  - 2008 CA IOU Potential Study Update
  - Database for Energy Efficiency Resources (DEER)
  - CPUC EE Goals Study

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History…

- Issues associated with reconciling EE in potential studies with reference forecasts are not new

- Late 1980s/early 1990s, SCE concerned with integrating:
  - Technology/end use forecast (MAPS) with EE program forecasts (COMPASS)
  - Mid-1990s RFP to build an integrated end use/EE program forecasting model – so-called “One World” model
    - RER builds ASSET model

- Many EE adoption modeling efforts early-/mid- 1990s
  - EPRI’s MarketTrek studies and tools
    - Multi-stage adoption models
  - Consulting firm models (e.g., DSM ASSYST, others)

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Overview of the ASSET Framework

- Asset incorporates concepts about:
  - Technologies
  - Markets
  - Utility costs
  - Customer usage patterns
  - Purchasing decision making
- To estimate technical, economic, market, program, and naturally occurring potential savings from the adoption of efficient energy using equipment
- Stock accounting algorithms allow for the tracking of initial equipment stocks, initial vintage distributions, and user specified non-linear decay of these stocks

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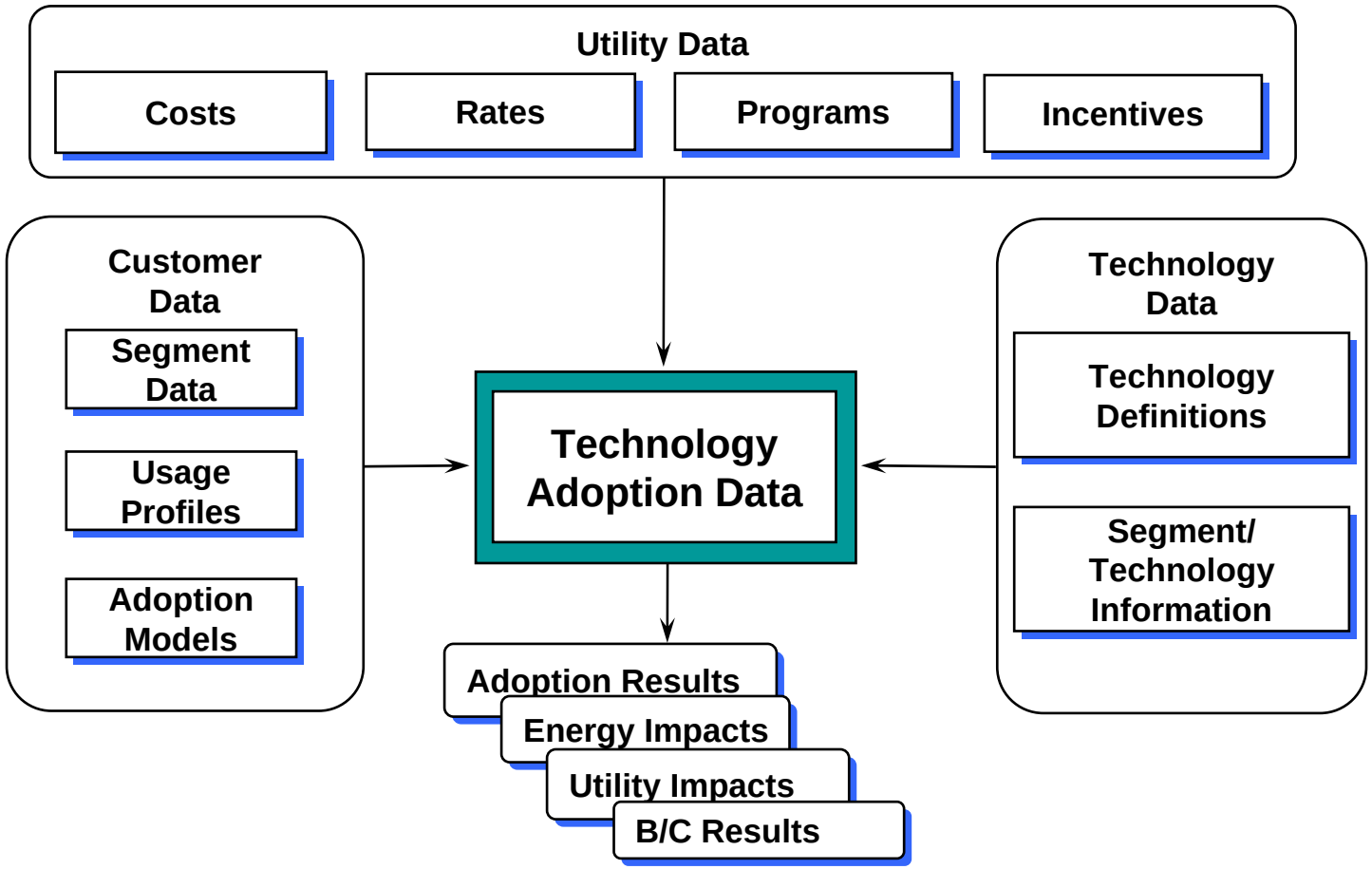
Asset Framework Data Requirements



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Key ASSET Modeling Features

- Event-Driven
  - Replace-on-burnout
  - New construction
- Discretionary decisions
  - Equipment conversion
  - Device retrofit
- Competition groups
- Multiple run options
  - Technical and economic potential
  - With programs (1), without programs (2)
- Gross and net impact accounting
- Dynamic equipment stock accounting
- Benefit/cost and margin tests

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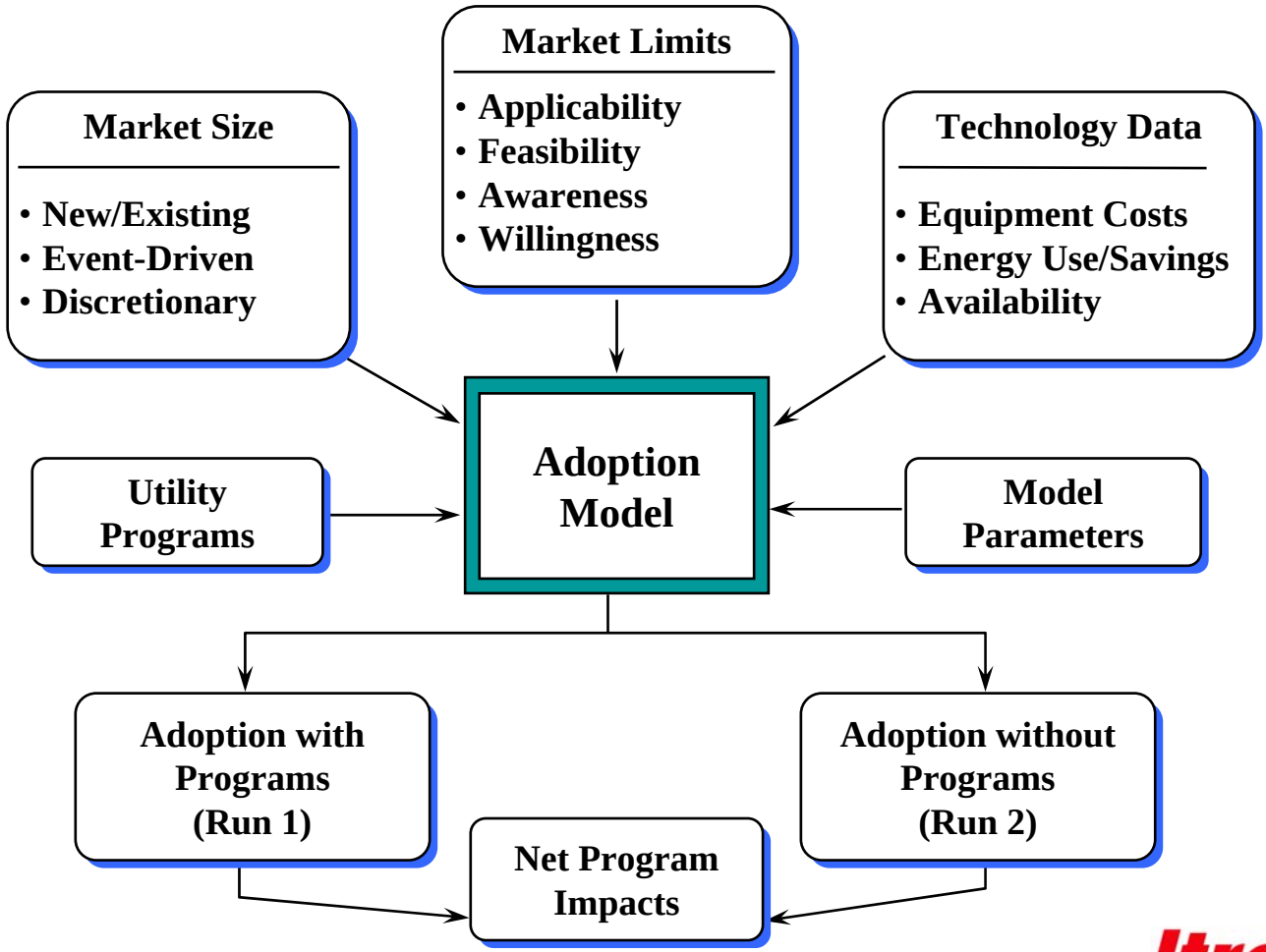
Adoption Model Framework



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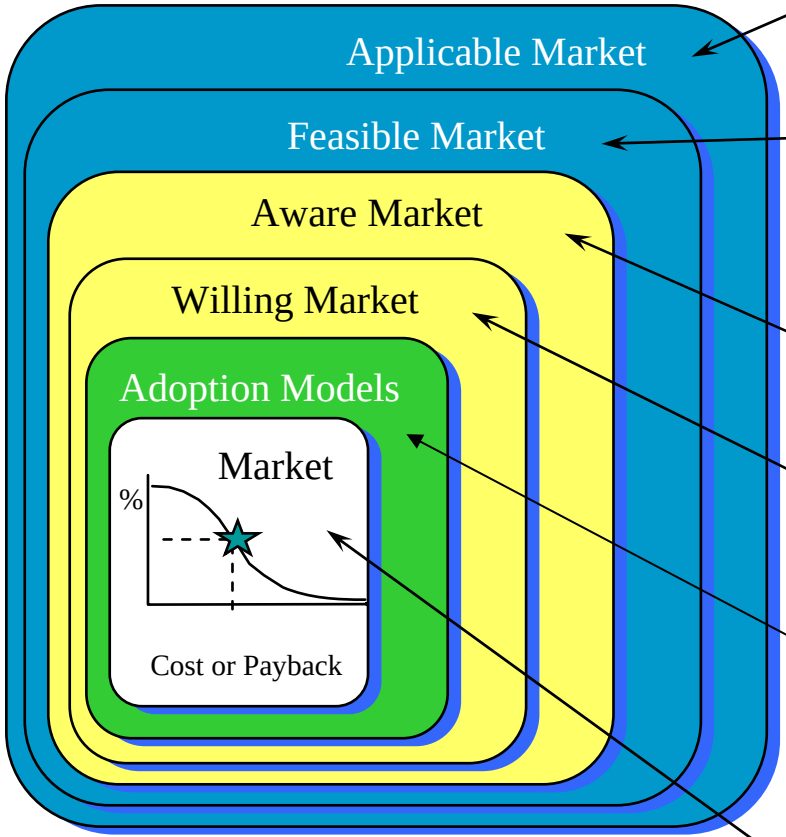
Technology Adoption Modeling Concepts



End-Use Saturations
Fuel Shares
Product-Class Shares

Physical Barriers
Practical Barriers

Technical Potential

Apply Cost Effectiveness Tests For Economic Potential

Information Costs
Diffusion

Non-Cost Attributes
Attitudes & Inertia

Decision Modeling
With and Without
Utility Programs

Availability
Equipment Costs
Energy Savings

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Modeling Concepts by Decision State

Decision State	New Construction	Replacement On Burnout	Equipment Conversion	Device Retrofit
Market Size	New units (homes, square footage, or capacity)	Amount of equipment decaying in the competition group less auto replacement.	Total amount of equipment in existing units for all options in the competition group.	Existing units (homes,square footage,or capacity)
Applicable Market	Fraction of new units with the qualifying equipment or configuration	Fraction of decaying units that are replaced (usually 1.0)	Maximum share of non-base options in the competition group (usually 1.0).	Fraction of existing units with the qualifying equipment or configuration.
Screens	Feasible, Aware Willing, Available for an Option	Feasible, Aware Willing, Available for an Option	Feasible, Aware Willing, Available for an Option	Feasible, Aware Willing, Available for an Option
Adoption Rate	Fraction of applicable units in which an option is installed.	Fraction of applicable decaying units in a competition group that are replaced with an option	Fraction of base option equipment that is converted to an alternative option.	Fraction of the applicable market that adds a device.

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Reporting

Reporting features

- Program and market impacts
  - Estimates adoptions with and without programs
  - User specified program eligibility tests
    - Adoptions of measures no longer eligible for programs, will be accounted for in the market and naturally occurring adoptions.
  - User determine program eligibility rules for the re-purchase of the existing high efficiency stock.
- Net program and market impacts
  - Estimates adoptions with and without programs
  - Estimates naturally occurring adoptions
    - Adoptions without the utility rebate
    - User specified awareness can be constant or allowed to grow to simulate market effects
  - Alternatively, user specified net-to-gross ratio can be applied
- The level of adoptions and energy data
  - 1st year and total; User and system level savings

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Technology

- User specified rebate payment on high efficiency technology repurchase
  - Repurchase of the existing high efficiency stock can be eligible for a rebate, partially eligible, or not eligible.
  - Rebate eligible purchases will be counted in program and market adoptions.
  - Rebate ineligible purchases will be counted in market and naturally occurring adoptions.
- Technology specific market and legal availability
  - Market availability used to increase the availability of a limited number of emerging technologies
  - Legal availability used for code changes
    - Base, mid, and high efficiency designators can change over time.

Potentials Included in the 2007 & 2008 Analyses

- **Technical Potential:** The most efficient technology option is selected subject to applicability, feasibility, and availability.
- **Economic Potential:** The most efficient cost effective technology option is selected subject to applicability, feasibility, and availability.
- **Current Market Potential:** A market simulation of the current utility programs assuming the continuation of current rebates. Restricted to measures currently in IOU programs.
- **Average Market Potential:** A market simulation of the current utility programs assuming a rebate half way between current rebates and incremental cost. Includes measures not currently in IOU programs.
- **Full Market Potential:** A market simulation of the current utility programs assuming a rebate equal to incremental cost. Includes measures not currently in IOU programs.
- **Naturally Occurring Potential**: A market simulation of energy efficiency adoption in the absence of further utility program interventions.
- For *Net Potential* we subtract naturally occurring

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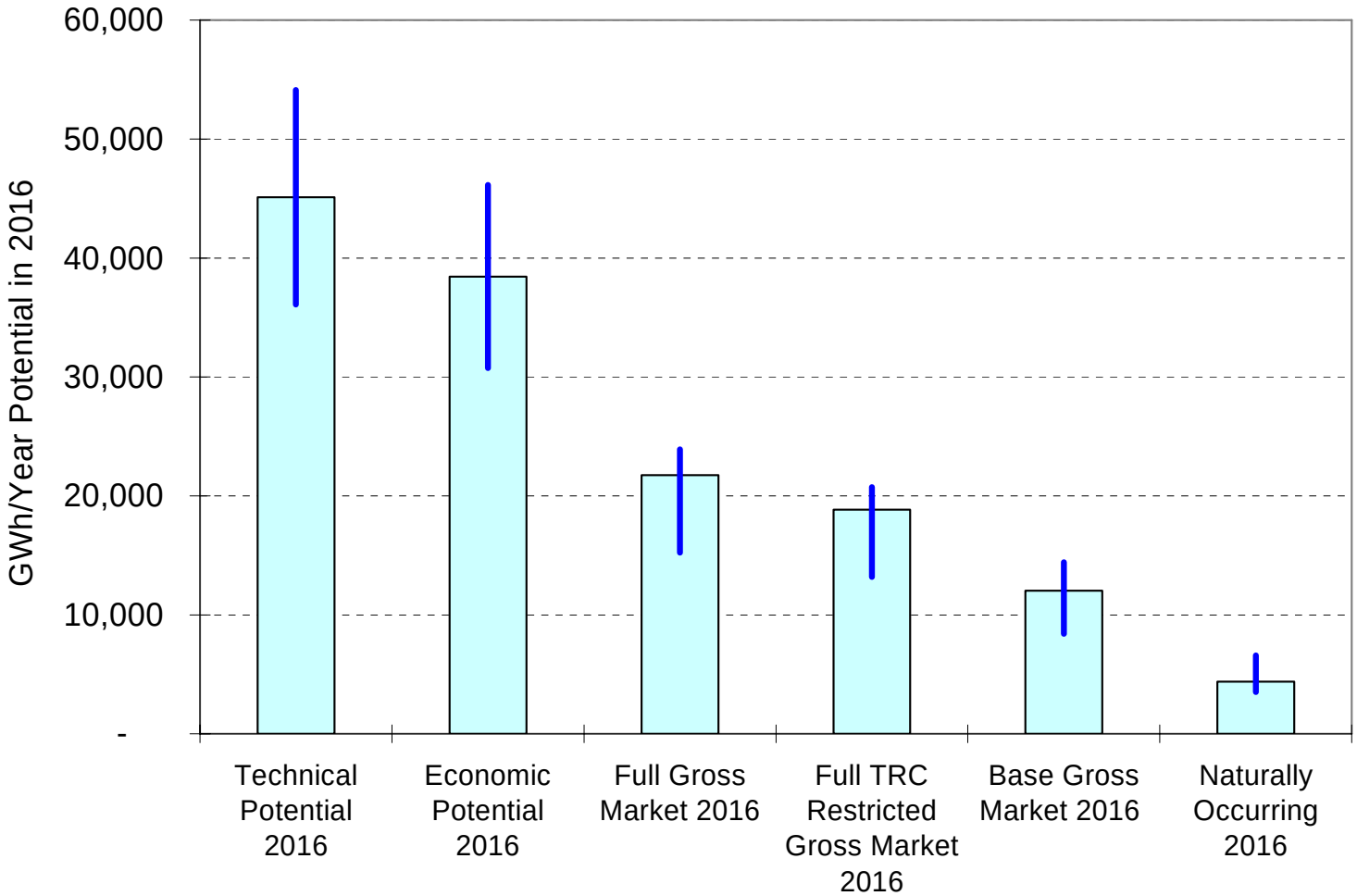
Draft 2007 Potentials with Illustrative Uncertainty Ranges



**Note: Naturally occurring calibrated to Base program level over the short term (2004-2005); depending on where market effects are assigned, naturally occurring could be significantly higher under the Base and Full incentive scenarios if market effects increase as compared to the calibration period.*

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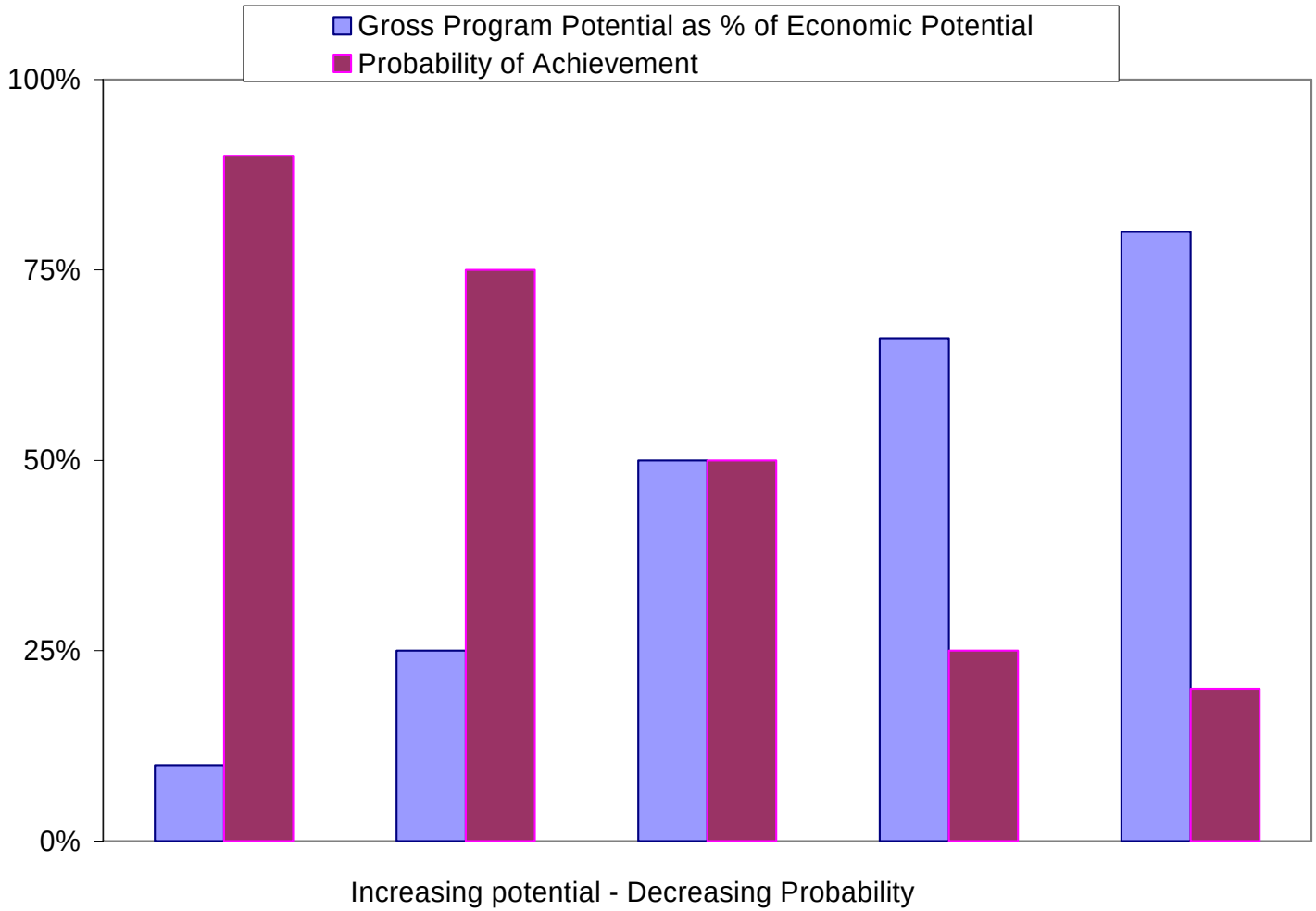
Voluntary Program Potential and Probability of Achievement (Illustrative only)



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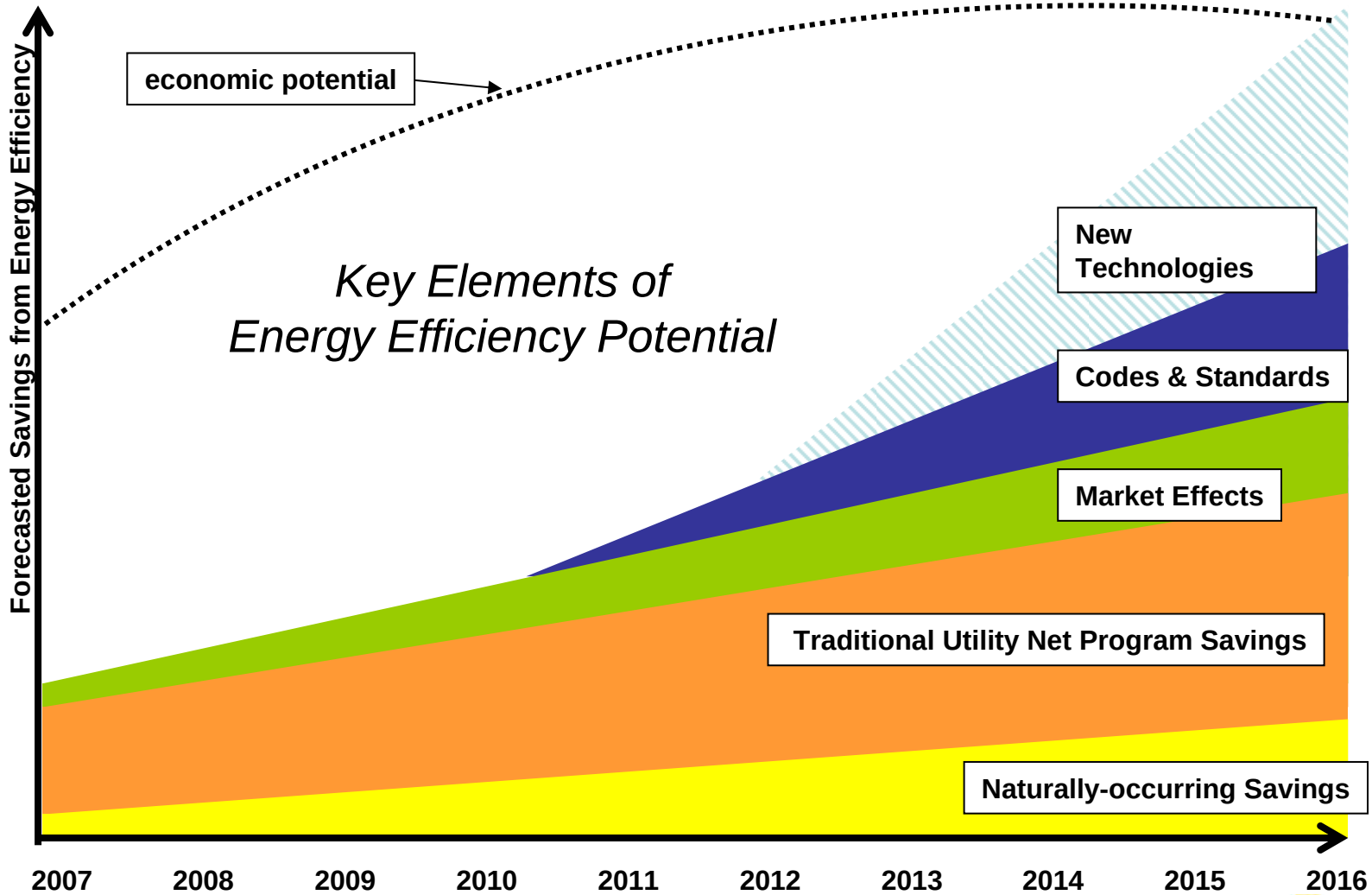
The Many Faces of EE Potential



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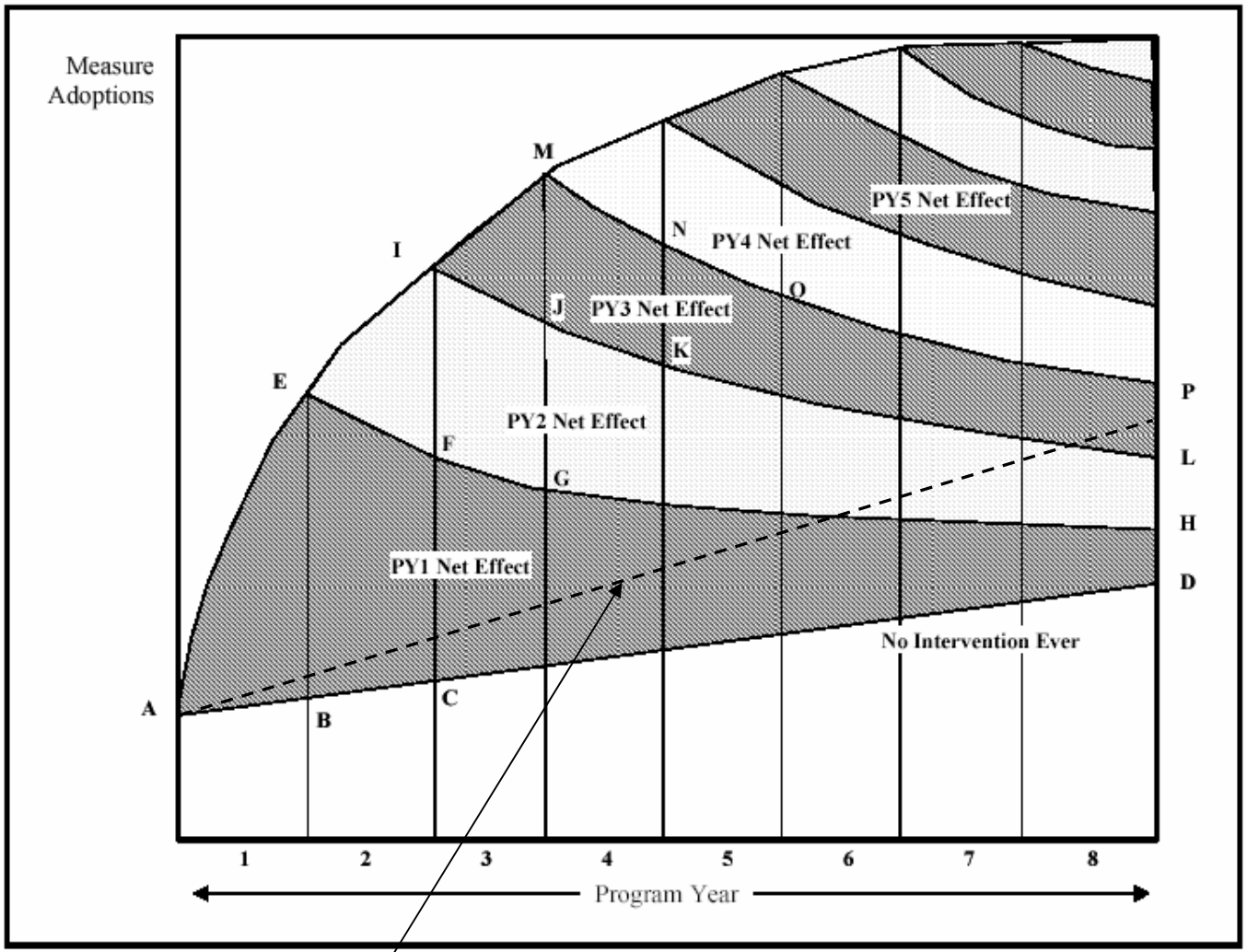
Program Effects are Often Acceleration (RER 2001)



No Intervention Ever PLUS Program-Induced Market Effects. This is what we "see" when we try to measure "free ridership". We are usually also picking up market effects from previous program efforts.

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Attribution is An Issue

- Attribution: What fraction of savings attributable to:
  - Recent IOU programs, historic IOU programs, national utility programs, codes & standards, natural market forces including prices effects (from when?)
- For EE potential forecasting and goal setting, attribution is important
- Attribution is a critical element of shareholder incentives
- Attribution is a critical task for EM&V
- Attribution varies over time
- Attribution is backwards and forwards issue
- Attribution may be of less direct import to forecasting models
- Even backwards attribution can be important politically

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Clarify Objectives and Definition of Reasonably Expected to Occur

- Objectives - Forecast the level of savings or efficiency expected in the entire economy or just from state or utility programs and over what time period?
  - If the former, more data collection may be needed to monitor and forecast measure saturations over time and model adoption behavior.
  - If both, attribution methodology may be needed.
- Definitions - Be clear about the level of efficiency impacts that are expected due to price impacts and whether this is a subset of naturally expected to occur impacts.
- Also what category gets credit for efficiency reinvestments originally due to programs?

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Key Differences in Model Definitions/Methods ASSET vs CEC Model

- Itron Objective - Help determine if ASSET methods or outputs can help CEC forecaster sort out potential overlap in savings between programs and other factors
- Identity key uncertainties in both models and understand how or if calibration with market data can reduce them
- Key differences in ASSET vs CEC forecast
  - Definition and Methods used to forecast Naturally Occurring Conservation or reductions in UEC's not attributed to program or standards effects.
  - Process of calibrating model to observed behavior or market data - measure level adoptions vs end use saturation studies.
  - Sequencing of program/category impact runs - price effects first, then standards, then programs?
    - Do programs lead to changes in naturally occurring rate of measure saturation?

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Other Comparison Issues

- When is time zero calibration point in models when savings start?
- How to model behavioral effects over time? A function of price spikes, mass marketing, others
- Understanding program impacts over different time periods; before and after lifecycle of first measure generation expires
- What happens when the first lifecycle of a measure expires and the same efficient measure is replaced ? What program or attribution category gets credit for second adoption of a CFL or replacement of a T-8

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Potential Studies Strengths and Weaknesses

- Strengths:
  - Use of saturation data
  - Use of stock accounting
  - Organizational framework
  - Calibration to program and market accomplishments
  - Tracking of savings over time
  - Works well with “widgets”
  - Estimation of technical and economic potential
  - Ability to efficiently handle multiple scenarios
- Weaknesses:
  - Lack of empirical data
  - Quality of data
  - Challenges associated with:
    - Discrete and static measure lists
    - Measure interactions
    - Systems/practices
    - Effect of economic vs. non-economic factors
    - Program and naturally-occurring adoption
    - Market effects over time
    - “Out-of-sample” initiatives
  - Data intensiveness often leads to false perceptions of precision
  - Provision of point estimates, limited presentation of uncertainty

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Factors Affecting Estimates of C-E Potential & Load

- **Savings Higher/Load Lower**
  - More rapid availability of new EE measures
  - Synergies of whole-building/systems approaches
  - Increased market transformation
  - Market effective marketing
  - Changes in behavior that lead to increased EE adoption
    - Willingness to accept less than fully equivalent service
    - Concern over GHG
  - "Big/Bold" strategies

- **Savings Lower/Load Higher**
  - Slower adoption and acceptance of key measures
  - Lower potential in less studied segments (e.g., Ag & TCU)
  - Increased energy service demands
    - Illumination levels, home size, plug loads, etc.

- **Savings Higher/Load Higher**
  - Low C&S compliance

- **Savings Lower/Load Lower**
  - Higher current EE saturation
  - Higher naturally occurring

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Elements of Uncertainty

- Numerous and significant elements of uncertainty pervade all potential studies
  - Some can be reduced through better baseline and evaluation research
  - Some are inherent to forecasting and very difficult to reduce
- If data and assumptions are unbiased, random errors will often cancel one another
  - Conversely, risk of systematic bias increases when inputs are driven by a particular point of view
- Greatest uncertainties are in:
  - Base usage, equipment, and measure saturations
  - Per unit costs and savings
  - Market potential estimates
    - Especially for most aggressive program scenarios and naturally occurring forecasts
  - Uncertainty increases as program potential moves toward economic
- Level of uncertainty increases need for scenario and risk analyses

- Additional uncertainty related to definition of net savings
  - Extent to which multi-year market effects are included or excluded

A Few Needs for Potential Studies

- Improve baseline end use and saturation data
- Improve data on marketing/information effectiveness
  - What are actual marketing effectiveness rates?
- Improve data on adoption (revealed preference)
  - What ever happened to experimental designs?
- Improve tracking of program accomplishments and overall efficiency market share
- Improve analysis of integrated design and practices
- Improve characterization of uncertainty and increase use of scenario analysis
- Increase transparency and understanding of empirical versus judgment-based inputs
- Develop simpler tools to support policy-making and input from key decision makers

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Potential Study Scope Issues to Keep in Mind

- Sectors, vintage, end uses
- Measures
  - Currently available, emerging technologies, both?
  - Hardware, practices, both?
  - Efficiency, behavior, both?
  - Equivalence of energy service levels?
- Base load forecasting
  - All load or targeted loads? Constant/non-constant energy service levels?
- Time horizon – 1 year, 5 year, 10 year, 20 year, 50 year?
- Calibrated baseline data?
- Avoided cost elements - Cost effective compared to what?
- Changes in barriers, cost/savings over time (market effects)?
- Stock accounting and adoption modeling
- Expected value, optimistic, or conservative orientation/bias?
  - Costs, savings, feasibility factors, adoption curves
- Policy options included
  - Voluntary programs, mandatory programs, codes and standards, social marketing, other?

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